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THE TOXICITY OF HAPLOPHYTON CIMICIDUM A. DC. TO FRUITFLIES

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INTRODUCTION

Among the insecticides used in the campaign against the Mexican fruitfly (*Anastrepha ludens* Loew) that was conducted in Cuernavaca and Yautepec, Morelos, Mexico, in 1900 was an extract of the dried stems and leaves of *Haplophyton cimicidum* A. DC. At that time the plant was so abundant near Yautepec that it could be obtained for only the cost of cutting it, which was 37 centavos (then about 18 cents in United States currency) for 30 or 40 kilograms (*7, p. 45*).[1] Although the writer has found the plant less abundant, a native collected for him, within a few days at a cost of 42 cents a day, about 300 kilograms in the mountains near Cuernavaca. Preliminary tests indicated the toxicity of this material and seemed to warrant further studies on its use as an insecticide for fruitflies. Investigations of the insecticidal value of the plant might lead to its cultivation in places where labor is cheap. It has been reported by De la Barreda (*7, p. 188*) as having been grown successfully on a ranch in Cuernavaca, although a few seeds that the writer planted in a box of soil in the same State gave only plants that were weak and soon died.

PREVIOUS INVESTIGATIONS[2]

Haplophyton cimicidum has been used in Mexico since time immemorial for killing cockroaches, flies, mosquitoes, fleas, lice, and other insects. According to Flores (*4*), the insecticidal properties were recorded by Francisco Hernandez as early as 1575. Early Mexican

[1] Italic numbers in parentheses refer to Literature Cited, p. 10.

[2] Since this circular was submitted, Clark isolated quebrachite from the stems of this plant. Clark, E. P. The occurrence of quebrachite in the stems of haplophyton cimicidum. Jour. Amer. Chem. Soc. 58: 1009-1010. 1936.

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workers tried the insecticide against nearly 20 species of insects and listed such diverse forms as the nymphs of the membracid *Antianthe expansa* Germ. and larvae of the Mexican bean beetle (*Epilachna varivestis* Muls.) as having been killed by it. They also reported that an extract of the plant had been successfully used in the destruction of head lice, dog fleas, and cockroaches. Some of these investigators realized, however, that *Haplophyton* contains a stomach poison, not a contact poison.

Shortly after the fruitfly campaign was begun, investigators of the Comisión de Parasitología (Betanzo, *7, p. 28*) indicated the efficacy of an extract of this plant against the house fly (*Musca domestica* L.), and later (Rangel, *7, pp. 28–30*) they found it to be a good insecticide for fruitflies. Flies that have eaten this poison become paralyzed and subsequently die.

The work of the Comisión de Parasitología with *Haplophyton cimicidum* was followed by all sorts of experimentation with this plant, and some questionable results were reported. Thus, it is stated that insects in museum collections that had been bathed or injected with this poison were not destroyed by dermestids (*7, p. 46*), that one physician used it with some success in treating an epileptic patient (*7, p. 54*), and that a dog sick with scab was cured on being bathed in an extract of the plant (*7, p. 55*). Experiments to determine the therapeutic value of the plant carried on with dogs at the Instituto Médico (*4*) were so variable that no conclusions could be drawn concerning its action on warm-blooded animals.

Drake and Spies (*3*) and A. C. Baker [3] found extracts of the plant to be nontoxic to goldfish.

Haplophyton cimicidum was described by A. de Candolle in 1844 (*1*). The scientific synonymy and an interesting narration as to how the plant happened to be described by De Candolle were given in 1907 by Flores (*4*) in a general paper on its botany and chemical composition and the physiological effects of the active principle. More recently the plant has been mentioned by Drake and Spies (*2, 3*), Martínez (*5, 6*), and Standley (*8, pp. 705, 1160, 1162–1163, 1166*).

Flores (*4*) has given an extended account of the chemistry of *Haplophyton cimicidum* based on the analysis of a 100-g sample. His information concerning the toxic properties of the active principle, which he called an alkaloid, does not agree with observations recorded here. Drake and Spies (*2*) isolated mannitol while investigating the insecticidal properties of the plant.

DESCRIPTION

Standley (*8, pp. 1162–1163*) described *Haplophyton cimicidum* as follows:

> Plants slender, herbaceous or woody below, usually 30 to 60 cm. high, the stems puberulent; leaves opposite, short petiolate, ovate or lanceolate, 3 to 5 cm. long, long-acuminate, rounded at base, hispidulous; flowers few, terminal, pedicellate, yellow; calyx eglandular, 5-parted, the lobes linear-subulate; corolla salverform, the lobes 12 to 15 mm. long, longer than the slender tube; follicles very slender, 6 to 8 cm. long; seeds with deciduous hairs at each end.

According to Martínez (*6*), the plant flowers from July to September.

Most of the plants collected by the writer have been well over a meter high. On the other hand, his original sample, which was ob-

[3] Personal communication.

tained from an unknown locality near Cuernavaca and which was nontoxic to the adults of *Anastrepha ludens*, was only about 30 cm high. The leaves of this specimen were larger than those of the writer's tall plant, but in other respects they answered the botanical description of *Haplophyton cimicidum*.

VULGAR SYNONYMY

The Mexicans formerly called the plant *Haplophyton cimicidum* actimpatli—also actempatli and atempatli—which means "killer of fleas" (*4, 6, 8*). The plant is now commonly known in Mexico as la hierba de la cucaracha, and the name "cockroach plant" would seem to be an appropriate English equivalent. The common Spanish name has also been applied to *Dodonaea viscosa* Jacq. in Durango (*6; 8, p. 705*), and to *Secondatia stans* (A. Gray) Standl. in Durango, Sinaloa, Michoacan (*8, p. 1166*), Mexico (State), and Chihuahua (*5*). Flores (*4*) has given *S. stans* the same common name, while Herrera (*7, p. 49*) calls it (under *Trachelospermum*) la hierba de la cucaracha de Cuernavaca. In Oaxaca *H. cimicidum* is also known as raiz de la cucaracha (cockroach root) (*5; 8, p. 1163*).

DISTRIBUTION

Standley (*8, p. 1162*) gives the following distribution of *Haplophyton cimicidum:* "Sonora and Chihuahua to Veracruz and Chipas [Chiapas]; type from Tehuantepec, Oaxaca. Guatemala; Cuba; southern Arizona." Martínez (*6*) records it from the mountains of Tepechicotlan, Cuernavaca, Jojutla (Morelos); Cañon de Tomellin, Oaxaca; and the States of Hidalgo and Guerrero. Herrera and coworkers (*7, pp. 21, 45, 90*) cite records of the plant's occurrence on the Hacienda de Alihuayan, near Yautepec, Morelos; on the Hacienda de Julapa, Actlán, Puebla; near Guaymas, Nayarit; on the plains of Santa Eulalia, Chihuahua; in rocky crevices near Magdalena, Sonora; in rocky canyons in New Mexico; and in the Santa Catalina Mountains near Tucson, Ariz. They also cite La Flora Habanera, by Gómez de la Maza, as mentioning the occurrence of the plant in Cuba, and Gray's Synoptical Flora of North America as recording *H. cimicidum* growing in rocky crevices in Mexico, Guatemala, and Cuba.

The writer purchased the plant in the market at Iguala, Guerrero, Mexico, December 1931, and has found it growing in shade on the southern and southwestern slopes of a small mountain (altitude nearly 5,200 feet) located between the towns of Jiutepec and Mango, Morelos. Blossoms were present August 22, 1932.

TOXICITY STUDIES

The toxicity of extracts of *Haplophyton cimicidum* to fruitflies was tested at Cuernavaca during the winter of 1931–32 and at Mexico City in 1932–33. The extracts were prepared by boiling definite quantities of the pulverized dry leaves with water for at least an hour and then removing the solid material by squeezing it in a cloth followed by filtering through cotton cloth. The extract so obtained was measured and, before being applied as a spray, was diluted with water to the desired volume and various percentages of molasses were added. The concentration was expressed as grams of pulverized dry leaves per 100

cc of diluted extract. Tests were made to determine the effect of the concentration of the diluted extract, the percentage of molasses in the spray, and the length of time and the manner in which the material was kept before being made available to the flies. At Mexico City the effect of temperature was also studied.

TESTS AT CUERNAVACA

At Cuernavaca the tests were run under insectary conditions, the mean temperature being about 20° C. (68° F.), with adults of *Anastrepha striata* Schiner as the test insects. The spray was applied in 10-cc portions to similar quantities of mango foliage held in glass vials containing water. When dry, the foliage was placed in cages, each with 40 well-fed mature flies of known age and sex. The cages were 11 by 11¾ by 12 inches, with glass tops and fronts, muslin-covered sides, and wooden bottoms. Moist absorbent cotton in a watch glass was kept in each cage throughout the test. The flies were placed in the cages late in the afternoon, and examinations to record the number of dead and paralyzed flies were made at about the same time on succeeding days. Results are shown in table 1.

TABLE 1.—*Toxicity of various dilutions of aqueous extracts of dried leaves of Haplophyton cimicidum, when sprayed on mango foliage, to adults of Anastrepha striata, Cuernavaca, Morelos, 1931–32*

Cage no.	Leaves for 100 cc of diluted extract	Molasses	Age of extract when used	Manner of holding extract	Flies	Average longevity of flies	Time before all flies were paralyzed or dead	Mortality in check cages
	Grams	*Percent*	*Days*		*Number*	*Days*	*Days*	*Percent*
163–164	12.5	20	1	Dry on foliage	75	9.0	4.5	2.5
			35	do	80	5.1	3	5.0
			59	do	79	6.3	3	0
186–188	12.5	20	24	In solution	118	6.3	2	0
229	12.5	10	58	do	41	3.8	1	15.0
230	6.25	10	58	do	39	3.7	1	15.0
231	1.4	10	58	do	40	(1)		15.0

[1] 52.5 percent dead in 19 days.

With sprays containing 12.5 g of leaves per 100 cc and 20 percent of molasses, all the flies were dead or paralyzed in 4.5 days, and the maximum average longevity was about 9 days. The flies lived longer, and became paralyzed more slowly, when the molasses content was 20 percent (cages nos. 186–188) than when it was only 10 percent (cage no. 229). With the same percentage of molasses, sprays from 6.25 g of leaves (cage no. 230) were just as effective as those from 12.5 g of leaves (cage no. 229). When the concentration was reduced to 1.4 g of leaves (cage no. 231), the spray was not sufficiently toxic to kill all the flies in 19 days. The sprays prepared from the sample of *Haplophyton* used in these tests did not lose their toxicity when held 58 or 59 days either in solution or mixed with molasses and dried on mango foliage (cages nos. 163–164, 229–230).

TESTS AT MEXICO CITY

The tests at Mexico City were similar to those made at Cuernavaca except that 5-cc portions of spray material were applied on pebble-

glass plates (11.5 by 15 cm); the cages were smaller (7¾ by 12 by 12 inches); the temperature and humidity were kept constant; and records were made twice daily, in the morning and in the evening. *Anastrepha ludens* was the species used. One series of tests was conducted at 35° C. (95° F.) and 30-percent relative humidity, and another at 25° C. (77° F.) and 60-percent relative humidity. The results are shown in table 2.

TABLE 2.—*Toxicity of aqueous extracts of dried leaves of Haplophyton cimicidum to adults of Anastrepha ludens, when sprayed on glass plates, Mexico, D. F., 1932–33*

AT 35° C. AND 30-PERCENT RELATIVE HUMIDITY

Cage no.	Flies	Leaves for 100 cc of extract	Molasses	Age and treatment of spray [1]	Average longevity of flies	Time before all flies were paralyzed or dead	Mortality in check cages
	Number	*Grams*	*Percent*		*Days*	*Days*	*Percent*
406–407	79	22.2	10	In solution 1 day	1.56	1–3	5.0
410–411	78	20.8	10	do	1.37	1.5	5.0
399–400	79	22.7	20	In solution 3 days	1.20	1–1.5	2.5
401–402	79	22.7	10	do	1.45	2	2.5
403	41	22.7	20	do	1.41	1	2.5
404	39	22.7	50	do	1.92	3	2.5
336–338	118	12.5	20	In solution 190 days; dried and held 9 days at 35° C. and 30-percent relative humidity.	2.93	3–4	17.5
				In solution 190 days; dried and held 19 days at 35° C. and 30-percent relative humidity.	2.67	2–5	22.5

AT 25° C. AND 60-PERCENT RELATIVE HUMIDITY

700–702	119	22.7	18	Dried and held at room temperature 15 days	3.40	3–5–4.5	2.5
670	39	22.2	10	Dried and held at 35° C. and 30-percent relative humidity for 182 days and at 30° C. and same relative humidity for 126 days.	4.02	4	2.5
671	40	20.8	10	do	4.90	4.5	2.5
673	39	11.4	10	Dried and held at 35° C. and 30-percent relative humidity for 184 days and at 30° C. and same relative humidity for 126 days.	5.55	6	2.5
674	39	22.7	10	do	4.53	4	2.5
675	40	22.7	10	do	4.47	3.5	2.5
668	40	22.7	20	do	4.35	3	2.5
653	40	12.5	20	In solution at room temperature 527 days	(2)		5.0
669	38	12.5	20	In solution 190 days; dried and held for 232 days at 35° C. and 30-percent relative humidity and for 126 days at 30° C. and same relative humidity.	(3)		0

[1] None of the solutions were held with molasses, but all sprays on glass plates were dried with stated percentages of molasses.
[2] No flies died.
[3] 37.5 percent of the flies died in 14.5 days.

At 35° C. and 30-percent relative humidity the average longevity of the flies was always less than 2 days with extracts from 20.8 to 22.7 g of leaves in solutions 3 days old or less containing 10, 20, and 50 percent of molasses, and not more than 1.6 days with 10 and 20 percent of molasses. If less molasses had been used, the flies probably would have succumbed even sooner at this temperature. When exposed to sprays from 12.5 g of leaves that had been held in solution without molasses for 190 days and then dried with molasses on glass plates for

9 to 19 days, the flies lived less than 3 days (cages nos. 336–338). It is thus seen that the spray lost little of its toxicity on long standing.

At 25° C. and 60-percent relative humidity sprays prepared from 11.4 to 22.7 g of leaves containing both 10 and 20 percent of molasses were toxic after being held on glass plates for 182 to 184 days at 35° C. and 30-percent relative humidity and for 126 days longer at 30° C. and the same humidity (cages nos. 668, 670–675). Under these conditions the flies lived an average of 4 to 5.6 days. Flies exposed to sprays held in this manner lived an average of one-half to 2 days longer than flies exposed to sprays of similar concentration that had been held only 15 days at room temperature (compare cages nos. 668, 670–675 with cages nos. 700–702). Nevertheless, the time before all the flies were dead or paralyzed was much the same, 3 to 4.5 days in all cages but one (cage no. 674, 6 days), irrespective of the age of the sprayed plates. Spray held in solution without molasses at room temperature (cage no. 653) completely lost its toxicity after 527 days. When a solution of the same concentration was held for 190 days at room temperature and then dried with 20 percent of molasses and held for 232 days at 35° C. and 30-percent relative humidity followed by 126 days at 30° C. and the same humidity (cage no. 669), it was still slightly toxic, as 37.5 percent of the flies were dead after 14.5 days.

PARALYTIC EFFECT

In making the examinations it was often impossible to distinguish a paralyzed from a dead fly without touching it. When a fly is first paralyzed, it gyrates on its back very rapidly for several minutes, apparently incapable of flying. The first day that it is in this condition it can be made to gyrate merely by touching the ventral surface of the body. If the fly remains paralyzed a second day, it becomes more quiet and in response to such stimulus will usually only twitch its proboscis or legs. These movements may be observed for several days and are detectable until the fly is nearly dead. The excreta of the flies that have ingested these sprays become dark brown and sticky, sometimes so much so as to hold paralyzed females by their ovipositors fast to the floor of the cage.

The data of table 3 indicate how rapidly the flies become paralyzed and how long the paralysis lasts. Fruitflies do not as a rule recover after having ingested enough poison to become paralyzed. Only 1 fly out of 40 paralyzed flies recovered when removed from exposure to the poison and placed in another cage with a piece of fresh orange. After the flies are paralyzed, it is doubtful whether they can feed. Under cage conditions they soon take a fatal dose of the poison, since apparently it is not in the least repellent to them. In fact, early investigators (*4; 7, pp. 29, 46*) noted that adults of *Anastrepha ludens* eat the poison with avidity and that the extract of the plant actually attracts Diptera. In the field a paralyzed fly is as good as a dead fly, because predators on the ground will soon destroy it if it is not killed by exposure to high temperature. It might therefore be included in toxicity calculations. If the paralyzed flies in these cages are included in the calculations, the average length of life is 1.4 days, as compared with 3.4 days when figured on the basis of mortality alone.

TABLE 3.—*Rate and duration of paralysis of adults of Anastrepha ludens due to ingestion of extracts of Haplophyton cimicidum, Mexico, D. F., 1932–33; 25° C. and 60-percent relative humidity*

Time (days)	Cage 700		Cage 701		Cage 702		Cage 705 (check)	
	Dead flies	Paralyzed flies	Dead flies	Paralyzed flies	Dead flies	Paralyzed flies	Dead flies	Paralyzed flies
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
0.5	0	1	0	5	1	10	0	0
1	0	12	0	22	0	27	0	0
1.5	0	24	1	29	2	30	0	0
2	0	37	1	30	3	29	0	0
2.5	7	32	6	28	15	18	0	0
3	8	23	4	27	1	17	1	0
3.5	4	[1] 20	12	15	13	[1] 5	0	0
4	5	15	6	9	3	2	0	0
4.5	12	3	7	[1] 3	2	0	0	0
5	2	1	1	2	----	----	0	0
5.5	1	----	2	----	----	----	0	0
Total	39	----	40	----	40	----	1	----

[1] All flies dead or paralyzed.

COMPARISON OF TOXICITY OF TWO SAMPLES OF HAPLOPHYTON

The toxicity of various concentrations of sprays made from two samples of *Haplophyton* leaves is compared in table 4. Sample 1 was furnished by officials of the State of Morelos. Sample 2 was obtained in the mountains near Cuernavaca. Each spray contained 4.76 percent of molasses and was tested on adults of *Anastrepha ludens* at 25° C. and 50-percent relative humidity, 40 flies to a cage. Since only part of the flies exposed to the spray from sample 1 succumbed, the toxicity data cannot be summarized in the same manner as those for sample 2. A spray prepared from sample 1 killed only 51.3 percent of the flies in 4.5 days when 33.3 g of dried leaves were used to make 100 cc of extract, whereas with sample 2, 3.3 g of dried leaves killed all the flies in an average of 1.4 days.[4] These data emphasize the variability in the content of the toxic principle in different samples of the plant, and indicate the necessity of identifying and isolating the toxic principle so that standard sprays can be prepared.

TABLE 4.—*Comparative toxicity of aqueous extracts of two samples of dried leaves of Haplophyton cimicidum containing 4.76 percent of molasses to adults of Anastrepha ludens at 25° C. and 50-percent relative humidity*

Leaves per 100 cc of diluted extract (grams)	Sample 1		Sample 2			
	Cage no.	Mortality of flies in 4.5 days	Cage no.	Average longevity of flies	Time when all flies were dead or paralyzed	
					Maximum	Average
		Percent		*Days*	*Days*	*Days*
33.33	933–934	51.25	943–944	2.3	3.0–3.5	1.4
25.00	935–936	52.50	945–946	2.4	3.0–3.5	1.7
16.66	937–938	30.00	947–948	2.9	3.5–4.0	1.5
8.33	939–940	15.00	949–950	2.8	[1] 3.0	1.3
3.33	941–942	11.25	951–952	3.2	3.5–4.0	1.4
Check	----	10.00	----	[2]	----	----

[1] 1 fly lived 4.5 days after becoming paralyzed.
[2] 20-percent mortality in 3 days.

[4] Martínez (*6*) recommended a decoction made from 400 g of the powdered plant and 1 liter of water.

NOTES ON THE CHEMISTRY OF HAPLOPHYTON CIMICIDUM

The writer followed practically all the general methods of studying alkaloids, as well as many specific methods used in isolating certain alkaloids, but he did not obtain the active principle of *Haplophyton cimicidum* in a crystalline state. Later attempts to obtain a standard material solely for the purpose of making comparable toxicity tests were apparently successful, but the results have not yet been corroborated by such tests.

The toxic material has been extracted from the stems and leaves, but not from the roots. After removal of the protein from aqueous extracts of the plant, flocculent precipitates were formed with nearly all the common alkaloid precipitants, including Mayer's reagent (potassium-mercuric iodide), phosphomolybdic acid, phosphotungstic acid, tannic acid, Wagner's reagent (iodine in potassium iodide), silicotungstic acid, gold chloride, and platinum chloride. No precipitate was observed when picric acid was added. The formation of precipitates with these reagents indicates the active material to be an alkaloid. Use of the common methods of isolating alkaloids from precipitates formed with Mayer's reagent and phosphomolybdic acid has resulted in the isolation of a toxic resinous material, and not a free white base or crystalline salt, as would be the result with a typical alkaloid. A similar toxic resinous material has been obtained by various other methods, as described later. The toxic material reduces Benedict's and Fehling's solutions and is adsorbed by animal and activated vegetable charcoals. No adsorption was noted with preparations of Lloyd's reagent prepared by the writer, but the activity of which was not checked.

Many aqueous extracts of the plant were made and concentrated. These concentrates were treated with 95-percent ethyl alcohol to precipitate protein and pectinate substances, and the alcoholic extracts were evaporated to dryness and extracted with most of the common organic solvents (ether, petroleum ether, acetone, chloroform, carbon disulphide, and carbon tetrachloride). Each solvent removed only a small portion of the toxic material, even though the extraction was repeated several times under a reflux condenser. These portions, upon being evaporated to dryness and then dissolved as much as possible in water or dilute hydrochloric acid, gave heavier and lighter colored precipitates with Mayer's reagent than did the original extracts. Only small quantities of the toxic resinous material were obtained when concentrated aqueous extracts were extracted repeatedly with ether and other solvents. No increase in the quantity of the final product results from the addition of various acids and alkalies to concentrated aqueous extracts.

Aqueous extracts obtained directly from the plant or from extracts made with ether or other solvents were made alkaline and observed under various conditions in attempts to procure the active principle as a free base. Where precipitation took place, the precipitate was the brown resinous material. Precipitation was not complete. It is possible that the toxic resinous material is the free base, but its physical characteristics are so markedly different from those of known alkaloids that attempts were made to obtain a base with physical properties more typical of alkaloids.

The pulverized dry leaves and stems of *Haplophyton* were also extracted directly with sulphuric ether or petroleum ether for several

days. Only a fraction of the toxic resinous compound was removed by repeated extractions. When ether extracts were evaporated to dryness and repeatedly extracted with warm 0.5-percent solutions of hydrochloric or sulphuric acid, only small quantities of the toxic resinous material were removed. Such extracts gave heavy precipitates with Mayer's reagent. When acid extracts were neutralized, no precipitate was formed.

Several of the common methods of crystallization were followed, and two nontoxic crystalline compounds were obtained. One method of crystallizing certain alkaloids consists in adding ether to a solution of the alkaloid in absolute ethyl alcohol. With this procedure a flocculent brown precipitate was formed, that was soluble in water and gave a good test for alkaloids with Mayer's reagent and a strong test for reducing sugars with Benedict's solution. The solution separating from the brown precipitate was evaporated to dryness, and the residue was partially soluble in water, a waxlike material remaining at the bottom of the beaker. The water-soluble portion gave a good test with Mayer's reagent.

Steam distillation of the pulverized plant for the detection of volatile alkaloids gave negative results. Only what appeared to be trimethylamine was obtained. It was not toxic to adults of *Anastrepha striata*.

Although the toxic resinous material is precipitated by the usual alkaloid precipitants, the departures from typical alkaloid behavior in other respects lead one to believe that it might be an alkaloid with physical and chemical properties very distinct from any known alkaloid, a salt from which the alkaloid as a free base can be separated only with difficulty, or an alkaloid glucoside. In this preliminary study the nature of the toxic material is only suggested, not proved.

SUMMARY

The plant *Haplophyton cimicidum*, commonly known as la hierba de la cucaracha (cockroach plant), has long been used in Mexico to kill cockroaches, flies, mosquitoes, and other insects. In the campaign against the Mexican fruitfly (*Anastrepha ludens*) in 1900, extracts of the plant were also found effective against that insect and many trees were sprayed with it. The effectiveness of the spray was confirmed by recent toxicity tests, which indicated that further studies were desirable.

Toxicity data were taken under varied conditions of temperature, concentration of spray, molasses content, and age of spray. In the insectary it was found that sprays did not lose their toxicity when held 58 to 59 days either in solution or mixed with molasses and dried on mango foliage. In the laboratory sprays lost little of their toxicity after being held 190 days in solution without molasses. Sprays mixed with molasses and held dry on glass plates at 30° and 35° C. and 30-percent relative humidity for 310 days retained much of their toxic property. A spray held in solution for 190 days, and then mixed with molasses and dried on glass plates held at 30° and 35° C. and 30-percent relative humidity for 358 days, remained slightly toxic. An extract held without molasses at room temperature for 527 days was not toxic. Sprays of the lowest molasses content were the most effective. The experiments show that a spray containing 3.3 g of

dried leaves of a good sample per 100 cc is toxic to fruitflies. Some samples of the plant are nontoxic or only slightly toxic to the fruitfly.

Observations on the paralysis of flies following the ingestion of sweetened extracts of the plant show that flies rarely recover from the effects of the poison. Paralyzed flies might be considered the same as dead flies in calculating the toxicity of extracts.

A chemical study of the toxic material in the plant leads to the belief that it may be an alkaloid, a salt of an alkaloid, or an alkaloid glucoside, although this is not yet definitely proved.

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